CLAIMS

1. An acoustic-to-electrical transducer for detecting body sounds, the transducer comprising:

a diaphragm having an electrically conductive surface, the diaphragm being mounted in a housing such that the diaphragm can make contact with the body and vibrate in response to body sounds;

a fixed conductive plate substantially parallel to the diaphragm, mounted within the housing, the conductive plate being positioned at a distance about or exceeding 0.1mm from the diaphragm, the diaphragm conductive surface and fixed conductive plate forming two plates of a capacitor and connected in the form of an electrical capacitance to electrical circuitry; and

a capacitance-to-electrical conversion means to convert diaphragm-plate capacitance changes due to body sound vibration to electrical signals.

2. The transducer according to Claim 1, wherein the diaphragm comprises a flexible electrically-insulated substrate with electrically-conductive material deposited or adhered on an inner plane.

3. The transducer according to Claim 1, wherein the capacitance is charged to a DC charge voltage by a DC to DC boost circuit, said boost circuit boosting an input DC supply voltage to a significantly higher DC charge voltage.

4. The transducer according to Claim 3, wherein the DC to DC boost circuit can be operated intermittently to reduce battery power consumption.

5. The transducer according to Claim 3, wherein the DC to DC boost circuit DC charge voltage magnitude is adjustable as a function of electrical signal amplitude or frequency characteristics of the output signal of the capacitance-to-electrical signal conversion means.

6. The transducer according to Claim 1, wherein the diaphragm conductive surface is connected to circuit ground potential to provide electromagnetic shielding for the transducer.

7. The transducer according to Claim 6, wherein a housing conductive surface is connected to circuit ground potential such that the diaphragm and housing conductive surfaces form an electromagnetically-shielded cavity for electrical circuitry housed within said cavity.

8. The transducer according to Claim 1 further comprising means to create a permanent static electric field between the diaphragm and conductive plate.

9. The transducer according to Claim 1, wherein the housing which includes the diaphragm and conductive plate forms a removable module which is attachable to or detachable from a stethoscope body, and includes means for mechanically and electrically coupling the module to a stethoscope body.

10. The transducer according to Claim 1 wherein the mounting means for the diaphragm and fixed conductive plate include acoustic isolation means to reduce vibrations of the diaphragm or conductive plate due to ambient sound; and electrical connection means to connect diaphragm-plate capacitance to capacitance-to-electrical conversion means.

11. The transducer according to Claim 1 wherein the capacitance-to-electrical conversion means includes one of the following steps for converting capacitance changes to electrical signals: (a) Varying the frequency of oscillation of an oscillator as a function of capacitance, (b) Varying the time constant of a circuit as a function of changing capacitance, (c) Generating a digital output signal which is a function of capacitance.

12. An electronic stethoscope including an acoustic-to-electrical transducer for detecting body sounds, the transducer comprising:

a stethoscope diaphragm having an electrically conductive surface, the diaphragm being mounted in a stethoscope chestpiece such that the diaphragm can contact the body for body sound detection and vibrate in response to body sounds;

a fixed conductive plate substantially parallel to the diaphragm, mounted within the chestpiece, the conductive plate being positioned at a distance about or exceeding 0.1mm from the diaphragm, the diaphragm conductive surface and fixed conductive plate forming two plates of a capacitor and connected in the form of an electrical capacitance to electrical circuitry;

a capacitance-to-electrical signal conversion means to convert diaphragm-plate capacitance changes due to body sound vibrations to electrical signals;

the stethoscope further comprising signal amplification means and at least one electrical-to-acoustic transducer connected to signal amplification means, to reproduce body sounds as detected by said transducer.

13. The transducer according to claim 1, wherein the space between the diaphragm conductive surface and fixed conductive plate further includes a layer of high dielectric electrical insulation material.

14. An acoustic-to-electrical transducer for detecting body sounds, the transducer comprising:

a diaphragm having an electrically conductive surface, the diaphragm being mounted in a housing such that the diaphragm can make contact with the body and vibrate in response to body sounds;

a fixed conductive plate substantially parallel to the diaphragm, mounted within the housing, the conductive plate being positioned behind the diaphragm, the diaphragm conductive surface and fixed conductive plate forming two plates of a capacitor and connected in the form of an electrical capacitance to electrical circuitry;

a capacitance-to-electrical conversion means to convert diaphragm-plate capacitance changes due to body sound vibration to electrical signals;

the capacitance-to-electrical conversion means having gain and frequency response characteristics that are adjustable by variation of the static displacement of the diaphragm due to pressure of the body against the diaphragm.

15. An acoustic-to-electrical transducer for detecting body sounds, the transducer comprising:

a diaphragm mounted in a housing such that the diaphragm can make contact with the body and vibrate in response to body sounds;

the diaphragm including means to modulate an electromagnetic signal via mechanical movement, said electromagnetic signal being an electric or magnetic field in the space behind the diaphragm or a light beam in the space behind the diaphragm;

the diaphragm being mounted such that the diaphragm can be displaced at least 0.1mm due to a combination of body vibration and static pressure of the body on the diaphragm;

conversion means to convert said electromagnetic signal to an electrical signal measurement of diaphragm movement.

16. An acoustic-to-electrical transducer according to Claim 15, wherein diaphragm displacement due to static pressure of the body against the diaphragm modifies the amplitude and frequency response of the electrical signal measurement of diaphragm vibration.

17. The transducer according to Claim 15, further comprising:

a permanently magnetized material attached to the diaphragm such that a magnetic field behind the diaphragm is changed due to displacement of the diaphragm;

a magnetic field to electrical signal conversion means placed behind the diaphragm to convert said magnetic field changes to an electrical signal.

18. The transducer according to claim 15, further comprising:

an electrical conductor attached to the diaphragm, said conductor connected to an electrical circuit such that the conductor generates a magnetic field behind the diaphragm;

a magnetic field sensing means placed behind the diaphragm and spaced at least 0.1mm from it, said magnetic field sensing means connected to an electrical circuit to convert magnetic field changes due to diaphragm movement to electrical signals.

19. The transducer according to claim 15 further comprising:

an electrical coil mounted to the diaphragm normal to the surface of the diaphragm;

a permanent magnet or electromagnet placed behind the diaphragm such that the electrical coil and magnet form a magnetic circuit such that diaphragm displacement produces changes in electrical coil current or voltage;

an electrical circuit connected to said electrical coil to convert diaphragm motion to an electrical signal.

20. The transducer according to claim 15 further comprising:

a permanent magnet or electromagnet mounted to the diaphragm normal to the surface of the diaphragm;

an electrical coil placed behind the diaphragm such that the electrical coil and magnet form a magnetic circuit such that diaphragm displacement produces changes in electrical coil current or voltage;

an electrical circuit connected to said electrical coil to convert diaphragm motion to an electrical signal.

21. The transducer according to Claim 15 further comprising:

an optically reflective plane on the diaphragm;

a light emitter placed behind the diaphragm emitting a beam of light aimed at said reflective plane;

a light detector positioned such that the reflected beam from the reflective plane impinges on the detector, said reflected beam being modified due to diaphragm motion;

a conversion means connected to said detector to convert diaphragm motion into an electrical signal.

22. The transducer according to Claim 15 further comprising:

an optically transmissive element mounted normal to the surface of the diaphragm that moves with diaphragm movement;

a light emitter and detector placed behind the diaphragm such the a light beam passes from emitter to detector through the movable optically transmissive element;

a conversion means connected to said detector to convert diaphragm motion into an electrical signal.

23. The transducer according to Claim 21 wherein the optically reflective plane has a spatial pattern such that reflection is a function of the point on the plane at which reflection occurs.

24. The transducer according to Claim 22 wherein the optically transmissive element has a spatial pattern such that transmission of light is a function of the position on the element through which the beam travels.

25. An acoustic-to-electrical transducer for detecting body sounds, the transducer comprising:

a diaphragm having an electrically conductive surface, the diaphragm being mounted such that the diaphragm can make contact with the body and vibrate in response to body sounds;

a fixed conductive plane substantially parallel to the diaphragm, positioned behind the diaphragm, the diaphragm conductive surface and fixed conductive plane forming two plates of a capacitor and connected in the form of an electrical capacitance to electrical circuitry;

a capacitance-to-electrical conversion means to convert diaphragm-plate capacitance changes due to body sound vibration to electrical signals;

the conductive plate and capacitance-to-electrical conversion means being combined on a semiconductor substrate to form an integrated circuit acoustic-to-electrical transducer.